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GEOGRAPHICAL RECORD

NORTH AMERICA

Relations Between Land and Sea on the Northeastern Coast of Labrador. To the physical geography of a region still little known scientifically A. P. Coleman makes a welcome contribution in "Northeastern Part of Labrador, and New Quebec" (*Geol. Survey of Canada Memoir 124*, Ottawa, 1921). The most impressive feature of the region is the relation between sea and land. The coast is one of the most bold and rugged in the world. Great promontories with nearly vertical cliffs 1,000 to 2,000 feet in height run out between an intricacy of deep fiords, and deep and narrow channels separate the fringing islands from one another and the mainland. On this proverbially stormy coast wave action is profound; it is "the most important destructive work now going on in Labrador, since the small glaciers are doing little, the clear water rivers are cutting but slowly, and general weathering must be going on very deliberately in a region where snow lies for eight or nine months and the summers are cool and comparatively dry." During the months of July, August, and September, when the fishing fleets frequent the shores, northeasterly winds of a monsoonal character are dominant. Gales are common and violent, especially in September. During their occurrence waves at exposed places pile up to more than fifty feet above sea level and the spray is hurled a hundred feet up the sides of the cliffs. The shore forms show the rapid headway being made by marine erosion. On the sharp cliff faces there are characteristic examples of hanging remnants of glaciated valleys, and there is no suggestion of recent faulting. The coast appears straight on small-scale maps, but in detail the seaward front trends in all directions.

Along most of the coast the tidal range is not great, but off Cape Chidley, the northern extremity, it amounts to from 30 to 50 feet in the spring tides whose force and magnitude are not surpassed even by the famous tides of Fundy. In places tidal anomalies have been observed; thus in Nachvak fiord early in August, 1916, there was a difference of two feet in the height of the two diurnal tides.

The third great dynamic force of the sea, the ocean current, also has a profound influence on this coast. The ice-laden Labrador Current is the main stream, though there appear also to be minor currents. Occasionally spruce wood is drifted into the northernmost fiords, swept into the main current apparently by northeasterly currents from Ungava Bay. The prevalence of on-shore winds means that the summers are cool and foggy: "the occasional southwest winds felt almost sultry in contrast with the ice breath from the waters of the Arctic current." The easterly winds, also, drift floe ice into the fiords, thus further contributing to the lowering of temperature. In connection with the comparatively rare westerly winds of summer a chinook effect is worth noting. The deeper north and south valleys have a comparatively warm dry climate. In late August the grassy floor of one such valley opening into Nachvak fiord was sere and yellow, and above the valley flat on the eastern side berries ripened much earlier than at Hebron 60 miles farther south.

The Temperature and Precipitation of Alberta, Saskatchewan, and Manitoba. The climatic limit to cultivation is perhaps the most important element to be considered in the development of western Canada's unsettled lands, and it is highly desirable that temperature and rainfall data in great detail be made available. This the Meteorological Service of Canada is doing in a series which began appropriately with British Columbia in 1915 (*Geogr. Rev.*, Vol. 1, 1916, p. 228), and which is now followed by "The Temperature and Precipitation of Alberta, Saskatchewan and Manitoba" (Ottawa, 1920), by A. J. Connor, Climatologist. Tables and maps constitute the body of this publication, most of the interpretation and application being left to others. The tables show for each year the dates of first and last frost at 204 stations and the monthly rainfall at 295 stations, arranged by watersheds; and the monthly means and extremes of temperature, rainfall, and snowfall by decades at the 38 stations with adequate records. The 16 maps (on large township base map, scale about 40 miles to an inch) show in great detail the monthly mean maximum and minimum temperatures and the April–May, June–July, August–September, and mean annual precipitation. Isotherms are given for every 2° F. and isohyets for every 1 or 2 inches.

The coldest district is near Hudson Bay, where in January the mean daily minimum temperature is below −32° F. and the maximum below −15° and in July below 40° and 66°, respectively. In summer, however, the Rocky Mountains are colder. The hilly region west of the large Manitoba lakes is cold, the mean daily minimum and maximum being in January below −18° and 3° F. and in July below 48° and 74°, respectively. The hills and dissected high plains not far east of the Rockies are also cold, being somewhat warmer in winter and colder in summer (higher altitude) than the eastern hills. Along the border of western central North Dakota the mean minima in January are as low as −10° F., where the cold waves seem to have their freest sweep southward. The warmest district is in southern Alberta. The highest winter temperatures (January mean daily minimum below 4°, maximum below 30°) occur near the mountains, where the chinook blows most often, eating the snow off the cattle ranges; and the highest summer temperatures (July mean minimum about 52° to 54°, maximum about 78° to 82°) are experienced farther east, about Medicine Hat and on the plains of southern Saskatchewan and Manitoba.

The average annual precipitation ranges from about 10 to 20 inches, 15 to 25 per cent of which falls in April–May, 30 to 40 per cent in June–July, 20 to 25 per cent in August–September, and only about 30 per cent in the colder half year. The April–May rainfall is greater than that of August–September in the west and less in the east, possibly because of the coldness of the eastern lakes in spring. The belts of hills (generally forested) are marked by rainfalls of 5 to 10 inches more than those of the neighboring lowlands, and in the Rockies of southwestern Alberta the excess is 20 inches (total, 31 inches). The southeast is in general the wettest, and the far northwest the driest.

Within the regions generally favorable to agriculture so far as temperature is concerned, the local uncertainties of rainfall are of prime importance. On this account Mr. Connor suggests the establishment of rainfall stations several years before settlement, especially in the climatically little-known region north of the 53rd parallel.

Charles F. Brooks

EUROPE

The Arrangement of Rural Population in Belgium. The appearance of a paper entitled "Carte régionale du peuplement de la Belgique," by Marguerite Lefèvre (*La Géographie*, Vol. 36, No. 1, June, 1921, pp. 1–34), is particularly opportune on account of my population study appearing in this number of the *Geographical Review*, and is of further interest in its confirmation of the conclusions announced in a paper published in the *Review* last year (Vol. 10, Oct., 1920, pp. 223–240).

Mlle. Lefèvre has based her investigation primarily on the Belgian topographical maps of 1:100,000 scale, combined with direct observation of the ground when demanded by the circumstances. She has concluded that the arrangements of the present day form definite regions of human significance, quite apart from all physical considerations, and may be subdivided into units which she terms *domains*. There is a region of dissemination in the north of Belgium separated from a region of agglomeration in the south, by a well-marked boundary, passing through Tournai, Seneffe, Brussels, Malines, Louvain, Léau, Tongres, Maeseyck. There are five domains in the north, and four in the south. The boundaries are transitional, and the characters of one domain may be sporadically encountered right within a neighboring one. The accompanying map is thus a tentative representation of the conditions.

The littoral domain comprises the seaside residences of the coast and the groups of small cottages in the cultivated "pannes" of the dune belt. Landward of these is the domain of large, isolated farms of the "polders." Domains of dispersion in bands are found in the northwest of Flanders and in the polders of the Scheldt. In the provinces of Antwerp and Limbourg, which are thinly populated, are found small hamlets and dispersions along the highroads. The domain of maximum dispersion, which is veritably "dusted" with houses, exists in Flanders, between Dixmude, Audenarde, and Courtrai. The houses are scattered everywhere, and the communal centers are only indicated by the church spires. Slight variations occur in Flanders, as where the Forêt d'Houthulst has caused a tendency towards clustering, or in west and French Flanders, where the small houses often stand in groups of two or three. Extreme dispersion exists in the Pays de Herve, also, where houses again occur in groups of two or more. In southwest Flanders, northern Hainault, and parts of the provinces of Antwerp and Limbourg, the development of large farms has emptied small areas immediately around them, rendering the "dust" less dense. This is regarded as a subform of the domain. Another subform is found west of Brussels, and in southeast Flanders where the innumerable roads, running in all directions, are lined with houses. These forms comprise the northern region.

In the region of agglomeration we have first the so called "nebulous villages" mainly in the Namur basin. They are regarded as the transition between the two regions. The normal type is expressed in the form of large settled patches, the houses lining the roadways. An exaggerated form exists in the industrial regions where the fields have shrunk in size to mere gardens. A further type, less dense than the normal, occurs in the basins of the Vesdre and Amblève. These constitute one domain. The domain of nuclear villages has two subdivisions, the large villages to be seen in Hesbaye, and the small, thinly scattered villages of the Ardennes, where house stands next to house. A domain of crossroad villages exists in forested localities, as around Sivry. The last domain recognized is characterized by an entire absence of villages, and very few farms, as around Chimay.

The origins of the present day forms are sought in ethnographic history and environmental and economic influences. The purely ethnographic explanation advanced by Meitzen (A. Meitzen: Siedelung und Agrarwesen der West- und Ost-Germanen, Berlin, 1895), is discussed and discarded as unsatisfactory. A pronounced ethnographic influence has nevertheless been at work. In Roman times the *Hofsystem* prevailed in the north (a system of small, clustered pastoral communities of Celtic origin), while the villa system (groups of closely and strongly built dwellings) existed in the south. As forms, they were essentially alike. The Frankish invasions of the third century established the *Gewannsystem* in the north, a one-field, agricultural system, looser in form than the older Hofsystem but, all the same, clustered in its nature. A *tendency* towards dissemination was thus introduced in the north, while the south remained unaffected.

Environmental influence is first worked out historically. The general course of events is very like that demonstrated for the Siebengebirge. In Belgium three periods are discernible. The first stretches from the earliest times to the beginning of the ninth century and was a period of slow but steady occupation of all the available open tracts. Places which originated during this period may often be identified by the terminations of the place names, but the original foundations of the villages concerned are no longer discernible. The period of extension began early in the ninth century. Active attack was now made on the forests and marshes. The earlier seats of attack are here also traceable by the place names. Overpopulation evinced itself in the interior in the ninth century and was relieved by a peaceful colonization of the reclaimed marshes. The final clearing of the forests and reclamation of the marshes, the latter aided by the retreat of the sea, were accomplished between the thirteenth and fifteenth centuries. The former was instigated in the south largely by the monasteries, and both activities were encouraged by the counts of Flanders. In the latter half of the nineteenth century the period of economic progress began.

Physical influences are numerous. The forests are regarded as having been of primary importance. In the first period their influence was negative. When expansion started, the northern and southern forests reacted differently, owing to their different subsoils. The great northern forests (La Charbonnière, for example) were almost obliterated and with especial ease in northern Flanders and the Campine, where they were less dense and more coniferous. They were supplanted by agriculture. The Ardennes were cleared only in patches, and a mode of life was followed there which has now disappeared. In the north the nebulous villages grew in places as the forest was cleared. In the south the crossroad villages arose. The depth of the water table has been of great importance. In the north it is generally close to the surface, and thus permits dissemination, though this result need not necessarily follow. In the south it is deep below the surface, and life clings to the valleys. The final question is, can each dwelling have its own well, or must one well suffice for a whole village, in default of stream supply? In the latter case, agglomeration will prevail, as in parts of Brabant and Hesbaye. The nature of the soil resolves itself into a question of soil quality and condition of the surface during damp weather. It has reacted to produce the large farms of the polders, the dispersion in bands in the polders of the Scheldt, and the similar dispersion, though for a different reason, in northwestern Flanders. The method of exploitation is next considered. The large farm is believed to lead to clustering, as in Hesbaye, and the agglomeration southeast of Brussels is believed to be the result, in part, of an obsolete pastoral method. The shifting soils on the banks of the Meuse on the Dutch frontier have also led to the establishment of clusters on the firmer patches. Topographical forms and climate are of minor influence in Belgium, but individual villages are sited in hollows to avoid the rough, cold winds. It is evident from this exposition that all the physical circumstances also have favored the development of dissemination in the north and of agglomeration in the south.

Economic influence has been most powerful during the last period, old forms having adapted themselves to the newer conditions as in the Campine, where the highroads and railroads have exerted special attraction, and in the industrial regions of the Namur basin, where the nebulous villages have extended to the exaggerated form of spider web groups, particularly in Hainault.

Mlle. Lefèvre's careful investigation of the subject was made, apparently, in ignorance of my first paper on rural populations, to which reference is made above. It is thus a most welcome piece of independent evidence confirming the main conclusions reached by me. Bearing in mind that my own investigation attacked the problem in a general way, and that Mlle. Lefèvre has dealt with Belgium in particular, it is remarkable that the types she has distinguished and their underlying physical controls and evolutionary development correspond almost completely with my conclusions. For review purposes I have used Mlle. Lefèvre's terms, but the reader will have no difficulty in identifying ,say, her "dispersion en bandes," with my "linear dispersion," etc. The important influence of the forests, admirably established in her paper, had entirely escaped my attention. In connection with my paper in the present number, the identification of domains is very important. Their subdivisions are small in extent and somewhat mask the correspondence between Mlle. Lefèvre's map and the one I have published, but there is here also a very welcome agreement.

In criticism, I cannot agree with the author that the domains are independent of physical circumstances. Throughout her paper the geological basement is almost entirely disregarded. No mention is made of the important work of Leriche, and no direct significance is attached to the *noms de pays*. Yet, the *noms de pays* are an expression of folk consciousness of the physical unity of the district and link the human with the physical factors. They also indicate the approximate extent of the natural districts, which are essentially geological units and which determine most of the physical conditions, both of hydrology and soil. The arrangement of population depends upon the siting of dwellings, and, though other factors also operate, site is primarily determined by physical conditions. A comparison of the topographical and geological maps is a convincing way of realizing the connection between the physical circumstances and the human adaptations to them. For instance Mlle. Lefèvre depicts a subdomain of nebulous villages of low density in the northeastern Ardennes. They occur on the Cambrian rocks of the Spa district and are absent on the predominant Devonians. Similar conditions obtain on the corresponding Cambrian tract in the southwest, around Rocroi. I have disregarded these minor variations in my own treatment of the subject, but they are of some importance. The vertical element in village distribution, for instance in Condroz, appears to have escaped attention, and so has the hydrological line in the Ardenne Condrusienne. Two very important economic questions have not been considered. The first is the effect of the systems of land tenure, on the disappearance of the old social systems. The second is the significance of the sizes of farm holdings. It is one thing to say that large farms developed in Hesbaye and led to agglomeration, but quite another to say that in Hesbaye, which is on the Cretaceous chalks, it requires a larger area of land to make farming profitable than it does in Flanders.

The paper is well illustrated with diagrams and a map, and supplies many useful references, especially to German work. The author is to be congratulated on the clearness and thoroughness of her work, and it is to be hoped that she will extend her researches to a consideration of the Belgian towns and cities.

M. Aurousseau

Urban Geography: A Study of German Towns. A general study of the towns of Germany by Walter Geisler, which has recently appeared ("Beiträge zur Stadtgeographie," *Zeitschr. der Gesell. für Erdkunde*, Berlin, No. 8–10, 1920, pp. 274–296), is of considerable importance. An intensive study of Danzig drew Geisler to numerous conclusions, which he has tested by applying them to other towns in Germany; he now announces a series of broad, general principles underlying the structure of the German town, which should have extensive application elsewhere. He treats the town as an object, an integral part of the civilized landscape, and seeks to explain its general bodily appearance, ground plan, and structure.

In urban regions we meet man's greatest transformations of the landscape. When a spot is first occupied the best available land is taken first for house construction, and the streets are then laid out in accordance with the scheme. The ground plan is thus determined, and the streets thenceforth become the *conservative element.* To understand the ground plan the history of the town must therefore be traced in full. German towns, with a few exceptions, have not arisen from villages. They have been deliberately founded, often by a ruler, and so come to have a set form. The types vary with locality and age. The old towns west of the Elbe are irregular and have a single or a forked main street as their ancient foundation; but later, in the thirteenth century, they took on an outlined form through circumvallation. The somewhat newer towns on the flat ground east of the Elbe, mostly founded by the Teutonic Order, are more regular in plan and show a systematic arrangement of constructions of public significance (castle, market place, church, etc.). They are well represented on the Vistula. In the Roman foundations in western Germany the old street mesh still survives (Cologne), but they follow no regular system.

The present street plan is the result of expansion. This has taken place either by natural outgrowth according to necessity, or by the conscious foundation of new, isolated suburbs, as in the west. The towns of the middle ages were spacious, enclosing plenty of land within the walls. This was necessary for defense but was in part the result of monastic influence. Hence, from the thirteenth to the nineteenth century, town growth was not accompanied by peripheral expansion. The towns used their open land, or new towns were founded, especially in the east. The growth of the thirteenth century transgresses the walls. There were thus three periods of growth, now represented by three series of streets, those of the foundational period, the *Ringstrassen,* due to the removal of the walls, and the outer streets of the nineteenth century. In the east the walls have been preserved and are considerable obstacles to development. The nineteenth century streets followed natural features at first and then were laid out with mathematical regularity. Now attempts are made to relieve the monotony and to bring them into harmony with pre-existing features. Main thoroughfares, main streets, and distributing streets are to be distinguished.

The ordinary town plan gives little information of value concerning the spaces occupied by buildings. The kinds of buildings need to be distinguished, and public buildings are divisible into three main groups. The traffic and administrative buildings seek with great difficulty to penetrate the heart of the town. Cultural institutions (*Kulturorgane*), if of the type only once visited, such as museums, seek the inner town, or a position on the *Ringstrasse,* on its margin. Those used frequently, like schools or churches, are evenly distributed. Others, like hospitals, seek secluded places. The military buildings are placed on the walls in the east and are removed from positions of activity in the west. Industrial buildings are of three kinds. Business houses (excluding those concerned with daily supply) line streets which coalesce to form the *core* of the town. The core has a low dwelling density and is represented in towns of all sizes. The thoroughfares radiate from the core and are wanting in small towns. Their extent and the size of the core depend on the extent of the hinterland. Warehouses characterize maritime towns and choose poor ground, if the handling of goods is not thereby impeded. They have often been replaced by dwelling houses in consequence of the increased draft of ships, which demands their migration (Speicher Insel, Danzig). Manufacturing buildings avoid the core entirely.

Dwelling areas have often only recently been separated from the manufacturing areas. Such trade as requires little room may exist here. The aspect of the town depends upon the height of the houses. This is best expressed by the number of stories. Their number increases with the size of the town, but large towns show great irregularity. House height is easily represented on a map, the striking feature being the great height of the core.

The houses themselves are always younger than the streets by a period ranging up to three centuries. Only the monumental buildings are as old as the streets. The classification of house types requires a broader basis than the architect would employ, and the classes distinguished include various architectural styles. In the town proper there are three main types: the gable house of the fifteenth to seventeenth centuries, the *Langhaus* (with hip roof) of the eighteenth and nineteenth centuries, and the lodging house of the nineteenth and twentieth centuries. It is possible to map them by districts, but some subtypes have a remarkable territorial distribution. The *Langhaus* type, for instance, is common in middle Germany, as at Cassel and Weimar. Out from the inner town are the semidetached and detached houses of the suburbs. The problem of making a map which would show both height and style of houses has not been satisfactorily solved. Land free from buildings—

parks, gardens, squares, etc.—should be mapped with especial care, owing to its tremendous economic and hygienic importance.

Population density may be expressed and mapped by the average number of residents per house, when the map will be found to correspond remarkably with the map of house heights. It may also be determined as kilometric density by town subdivisions. In these circumstances, the relation between the number of buildings and the open spaces should be carefully determined also. Choice of suitable subdivisions is difficult, and generally the administrative areas, like police districts, are most unsuitable.

The limits of the town are most difficult to determine. Hasse sets the limits at the line of abrupt decline of population density. Hassinger uses the limitations of the range of traffic, based upon the mean accessibility (= mean time of passage plus ½ time of delay) of the core from the suburbs. This is unsuitable, as many town dwellers have little concern with the core, and there is often more than one centralization point. The line of encounter of rural and urban activities has also been proposed and is very satisfactory for small towns like Biala, but with large towns there is an interpenetration of activities. Schülter's four zones of urban influence form a most useful conception, but in these days most villages show distinct urban influence, and farmed land between isolated suburbs always gives hints of pending absorption into the town. We are forced to fall back on a fast boundary, but it is useful to distinguish a natural settlement area (*natürlicher Siedlungsraum*) within which is a settled surface (*besiedelte Fläche*), as the relation between the two is a valuable measure of town development. Where the latter occupies the former fully, there is little opportunity for dilatation; and, if neighboring areas press one upon the other, we have the condition of grouped towns, illustrated by the industrial region of Rhenish Westphalia.

It is impossible in a mere abstract to avoid giving the impression that Geisler has often recorded nothing but the obvious, but the importance of the ideas expressed is amply verified by the discussion of numerous interesting examples from all parts of Germany. The paper is a welcome indication that the most intricate province of human geography will ultimately reveal its governing principles. Two things in particular are suggested. The first is that the investigation of the subject is best undertaken from a biological standpoint. We are concerned with the interactions between society and its surroundings. Society, the collective organism, is the highest expression of the organism, and for its own maintenance it sets aside organic groups, largely expressed as towns and cities. These may be examined according to function (physiologically), according to form (morphologically), as Fleure has done (*Geographical Review*, Vol. 10, 1920, pp. 357–374), or according to tissue (histologically), which is Geisler's method. The second indication is that all large cities would find their problems and development much more favorably under control by the employment of well-trained urban geographers.

M. AUROUSSEAU

On Population Estimates and the Case of Constantinople in Byzantine Days. A. Andréadès, professor of financial science in the University of Athens, went on a voyage of discovery into the dim shadows of third-to-thirteenth-century Constantinople to ascertain its number of people ("De la population de Constantinople sous les empereurs byzantins," *Metron*, Vol. 1, 1920, No. 2, pp. 68–119). He comes back convinced it was a city of a million in its best periods, dropping to a half million in dark days, and having 180,000 to 200,000 at its fall. The Byzantine Empire had from 15 to 20 millions. The estimates of the historians, he says, that the city had from half a million to a million are entirely conjectural. His own appear to be based on love of all things Hellenic, confirmed by faith. He wants to think of Constantinople as a city of a million. He reviews the gossip of the ages, welcoming large estimates and disdaining small ones. He would consent to any arbitration of opinions that was pledged to result in his favor.

Constantinople has never been counted, and there is no other way than counting to ascertain the number of inhabitants. There was a lively dispute about Detroit a few years ago. The citizens thought it had a million people. The census officials estimated it between 600,000 and 700,000. This today, in a land of statistics, halfway between two countings of the people, with a larger fund of information available in infinitely more exact form than we have of any period in antiquity.

If Byzantine writers of every century had written down their opinions of the size of their city, it would prove nothing at all. None of them ever made the attempt. The size of a city is not determined in that way. Mankind in Byzantine days had none of our modern familiarity with the notion of a million. Possibly it is not a very definite idea with many of us today, but at least we talk about it freely. Neither Greek nor Latin speech had any such word as a million in current use. Even now there are very few cities in the world containing a million: none in Australia or Africa, two in South America, four in North America, and eight in Europe. In Asia there are four counted ones in India and Japan with perhaps two or three uncounted ones in China. China is worth a word of comment in connection with estimates of old Rome and Constantinople; for it is not possible to determine the size of Chinese cities at all closely, although we have in addition to all the analogies used in the arguments about the ancient towns the possibility of comparison with other towns that have been counted—an enormous advantage—and the important privilege of personal inspection.

Andréadès does not think Foord's comparison of the acreage of Constantinople and London is fair. He prefers the closer-settled Paris or the congested parts of Naples. Now, if he is serious, he thinks of Constantinople as settled like the denser parts of Naples all over the peninsula. Immediately he admits that this method would have its dangers too, for "it would end in colossal figures"! As if we were to judge our method right or wrong according as it arrived at about the result we thought right. Foord thinks Constantinople never had 500,000 people. Andréadès does not like this result.

Somewhat in the same spirit he characterizes as an "example of vagueness" Beloch's statement (1898) that "Constantinople was the only large Christian city with population over 100,000, and probably a good deal over." He quotes Sozomen's boast that Constantine's city yielded nothing in size to Rome to argue from it a population of 800,000, regardless of the three objections (1) that a boaster may state the opposite to the truth, (2) that Rome may not have had 500,000 people at any time, and (3) that Sozomen did not know how large either city really was.

Rome, we are told, had in 412 A.D. about 46,603 *insulae,* in which poor men dwelt, and 1,797 *domus* of the rich. Constantinople had 4,387 *domus* and an unknown number of *insulae.* Andréadès assumes that Rome had a million people; and so he thinks if he knew how many *insulae* there were in Constantinople he would know its population. He is sure that the poor were very numerous indeed. However, the evidence he cites to prove it is mainly the inducements held out to the laboring class to come there. That may indicate not that there were many of them, but that they were scarce and desired! Andréadès states that Bury has written him that Constantinople must have been larger than Milan, and Milan had over 600,000 in 538 A.D., "because the Franks massacred 300,000 males when they took it in that year." I fancy the massacre was exaggerated, and also the size of Milan. St. John Chrysostom is quoted as saying there were 100,000 Christians in Constantinople. On this Andréadès makes the comment that "criticism regards the statement as a copyist's error." Also Chrysostom said there were 50,000 "indigents, who were a tenth of the citizens." Of this the author says "We will not stop on this text but ask, How did Constantinople get so many people?"

Villehardouin says that in the conflagration that accompanied the capture of Constantinople by the crusaders in 1204 more houses were burned than "there are in the three largest cities in France." Does Andréadès suppose that Villehardouin had counted the houses burned, or those of the three largest cities? He was doubtless trying to convey the idea of a very large number.

Less excusable still is the treatment accorded to the statements of Kritopoulos, that 4,500 were killed at the fall of Constantinople. This, says Andréadès, must refer only to soldiers killed. From the horrors told of the massacre he judges that 50,000 or 60,000 must have been killed in all. There is no hint in all the gossip cited that Constantinople had over 500,000 people.

The fact that old Rome and old Constantinople belonged to a prestatistical epoch does not justify the application in our day of prestatistical forms of reasoning. Old writers tell easily of enormous losses in population by war and pestilence. Much reference is found to them here. Consider the effect of the war on the population of Europe. Marin's figures give as the killed in battle, dead of their wounds, and reported missing, 8½ millions for the four years. Now, normally Europe has been increasing in population about 19 millions every four years, so that, unless the civilian deaths directly traceable to the war or the changes in birth and death rates so chargeable have amounted to 10½ millions, the total population at the end of the war would be greater than at the beginning. The fearful famines of India have never diminished the counted population of that country except in the single case of the period 1861–1871, in which occurred a falling off of one-tenth of one per cent.

One thing made clear by modern census counts is that population grows very strongly and steadily in all countries and that the industrial expansion that came in with the railway in the nineteenth century enormously favored and facilitated urban concentration by making it easy to gather food and supplies from wide areas. Now by definite count it is known that the most favoring agencies and the great expansion of the British dominions did not bring London up to million size till 1802, though all the world contributes to supply London, as certainly never happened to any city of antiquity. Paris did not reach that size till 1850, New York not till 1870, Vienna not till 1878, and Berlin not till 1880. Calcutta in the "teeming East," with all the stimulus of British commerce, did not attain a million till 1900. Under the different conditions of ancient life, with their feeble means of transportation, Old Rome and Constantinople would have been enormous with populations of 500,000 people.

MARK JEFFERSON

AFRICA

Spanish Penetration in Northern Morocco. Whether "Africa begins at the Pyrenees" or "Europe ends with the Sahara," Spain's claim to a special interest in Morocco is well founded. Even aside from the fact that the Strait of Gibraltar has not destroyed the geographical unity of the lands to the north and the south of this narrow passage, mere proximity would seem to make Spain's interest in the North African regions more direct than that of other European nations.

In spite of this fact, her penetration of the region has been very slow. First on the field, she has made the least advance in effective occupation of the African lands. The line of coast forts, *presidios*, established on these rocky points have served to protect her shipping from pirates and have provided sites for convict settlements. They have afforded her also a pretext for intervening occasionally in the political affairs of the Moroccan Empire, as when, after the war of 1869, the Spanish-Moroccan treaty opened the ports of the empire to world commerce. But, until recent years, her penetration went little farther. The present Spanish zones of influence have been defined in particular by the conventions of 1904 and 1912. The northern zone includes the districts of the Jebala and the Rif, roughly bounded on the south and east respectively by the Lukkus and the Muluya, excluding Tangier, which, with a small surrounding territory, was made an international area. The southern zone includes the quite separate territories of Ifni and Rio del Oro on the Atlantic coast farther south. In addition to these zones Spain holds as formal possessions the before-mentioned coast forts which have been held practically continuously from early dates, the Zafarina Islands (1848), Melilla (1497), Alhucemas (1673), the Peñón de los Vélez de Gomera (1508), and Ceuta (1580); all of them mere rock-supported citadels that occupy jutting points along the Mediterranean coast, partially or completely disconnected with the mainland. Beyond, she maintains but a precarious hold, as the recent successes of the native armies have shown, when the Spanish troops were driven back to the very gates of Melilla and her entire position was threatened. (For a description of Spanish Morocco see an article entitled "Marruecos," by Abelardo Merino Alvarez, *Bol. Real Soc. Geogr.*, Madrid, Vol. 62, 1921, pp. 1–168, with map.)

We need not look far for the cause of Spain's slight success in Africa. Part of it no doubt lies in the *indole* of the Spanish people themselves, part in the policy followed by the government. A large part of the difficulty lies, however, in the character of the land and its inhabitants.

A forbidding coast line, composed chiefly of the jutting ends of mountain ranges, or of high cliffs running parallel to the coast, has left little opportunity to tie the captured islands or promontories to a hinterland upon which they might be made to depend. Though numerous streams break through this series of cliffs, most of them reach the sea through deep narrow gorges which, if penetrated, give access to but very limited districts. So complete has been the separation of the Spanish coast *presidios* from the adjoining territory that even firewood and water sometimes have had to be brought to the garrisons from the Balearic Islands or from Spain, while the garrisons have had constantly to be on their guard against attacks from the shore. In the Peñón de los Vélez (a rocky islet only 90 yards from the coast) the occupants of the fortress have found it necessary, on occasion, to cover the streets with bags of sand in order to protect themselves from rifle fire directed against them from the cliffs of the mainland. Don Alfonso Merry del Val in "The Spanish Zones in

Morocco" (*Geogr. Journ.*, Vol. 55, 1920, pp. 329–349 and 409–422) tells of the difficulties encountered by the Spanish in their attempt to penetrate the interior.

The little-known mountains of the Rif and Jebala together form a physical entity (sometimes known as Little Atlas), closely related to the Betic Cordillera of southern Spain, quite distinct from the Middle and High Atlas. The northern system contains far less level land than the Atlas proper. Exposed to a heavier rainfall (though still rather dry in the eastern section) the hills have become highly dissected, forming an intricate network of hills and valleys.

The only advance made by Spain has been where she took advantage of the few bits of level land that exist within the territory of her zone. Thus at the western base of the Jebala, between the Strait of Gibraltar and the Lukkus River there is a small area of lowland over which, operating from the ports of Arzila and Laraiche, the Spanish forces have succeeded in establishing their authority, but only as far as to the foot of the hill country. The inhabitants of this region, sedentary agriculturists for the most part, have long been accustomed to submit both to the oppressive measures of the Emperor and to the attacks made upon them by the people of the hills. They offered little resistance to the Spaniards, probably being glad to seek the better protection of Spanish authority.

Again, at the eastern foot of the same range, from Ceuta southward to beyond the Wadi Martil there is a stretch of level land, chiefly sandy soil, little used except in the neighborhood of Tetuan. Taking the stronghold of Ceuta for a base, the Spanish have been able to reach the important center of Tetuan and even to threaten the sacred city of Sheshawan (Xexauen), upon whose streets, up to the present time, it is said, no white man has ever trodden, though it is less than 100 kilometers from Ceuta or from Tangier.

The only remaining plains are at the extreme eastern end of the protectorate. Where the Rif mountains give way to the valley of the Muluya and the Mar Chica there are extensive flat lowlands. The valley of the Kert also contains some level lands, as does also the Meseta between this latter and the Muluya basin. In these plains some of the inhabitants live in small villages or clusters of villages, and practice agriculture on a limited scale, chiefly without irrigation or with the simplest of canal systems. Others, particularly on the steppes of Mtalsa and Guerruao between the Muluya and the Kert valleys, are principally pastoral and nomadic or seminomadic, moving their *jiams* (tents woven of wool or of *esparto*) from place to place in search of pasture for their flocks or living in temporary structures made of posts and woven grass. Here Melilla has served as base of departure. By force of arms and by peaceable means the Spanish have been able to occupy much of this level country, although the proximity of ranges of hills such as the Quebdana and the hilly promontory of Tres Forcas has afforded frequent opportunity for attack by rebel leaders. It was from this district that large quantities of iron were mined and shipped to England during the war. Roads have been extended into the surrounding regions, and two short lines of railway have been built out from Melilla. The recent uprising of the tribes in this territory seems to have undone much that had been accomplished towards a permanent reduction of the interior, as, according to reports in the daily press, the Spaniards have lost, temporarily at least, almost all except the fortified city of Melilla itself.

French West Africa. The exhaustion of France during the war and the fear of becoming more and more dependent for food and raw materials on foreign countries has aroused among the French people of late a lively interest in the resources which their colonies offer for the supply to the mother country of products which she either cannot produce herself or cannot produce in quantities sufficient to satisfy the needs of home consumption. Gallic imperialists believe passionately in a self-sufficing French Empire and see in their great and, as yet, barely touched African domains a magnificent field for the exploitation of agriculture and of mineral wealth to benefit *la Métropole* and, incidentally, the colonies themselves.

This interest has been focussed to a very large extent on French West Africa, that enormous tract comprising, in the Sudan, the valleys of the Senegal and upper Niger and connected with the Atlantic and Gulf of Guinea by four broad "corridors," the colonies of Senegal, French Guinea, Ivory Coast, and Dahomey (which now includes part of the former German Togoland). From the administrative point of view the region was entirely reorganized in December, 1920; among other reforms the old military territories of Mauretania and the Niger were given administrative autonomy as colonies, and the name of the former colony of Haut Sénégal et Niger was changed to "Soudan Français" (*Colonies* *et Marine*, Vol. 5, 1921, pp. 161–178). During the war an extremely valuable bibliography and estimate of the scientific work of all sorts that had been carried on in French West Africa appeared in *Renseignements Coloniaux* (*Suppl. à l'Afrique Française*) for January-February, 1916, pp. 3–26, which, together with Joucla's "Bibliographie de l'Afrique Occidentale Française" (Paris, 1912) now forms an invaluable introduction for whoever wishes to make researches into the geography of the region.

From the economic point of view a multitude of studies have recently appeared advocating the exploitation of French West Africa. These all agree on two points: (1) the necessity for the development of the productive capacity (particularly the agriculture) of the region and (2)—of even greater importance—the necessity for the perfection of an economic mechanism (*outillage économique*) capable of developing this productive capacity to the utmost and making its products available to the outside world. The importance of pushing forward enterprise along both of these lines was set forth during the war by Gustave Regelsperger in a broad presentation of the existing economic situation and future prospects of French West Africa (*Rev. des Sci. Polit.*, Vol. 36, 1916, Dec. 15, pp. 333–359) and, more recently, by M. Merlin, the governor-general, in a speech of December 29, 1919 (*Renseign. Colon.*, February, 1920, pp. 37–40), in which he vigorously urged, among other things, the promotion of large-scale farming, cotton cultivation, and the widest possible building of ports, railways, highways, and other public works.

From the standpoint of economic geography, Henry Hubert, one of the leading authorities on West African geology and physical geography, summarized the status of the colonies in an admirable article entitled "L'influence du facteur géographique dans le développement économique de l'Afrique Occidentale Française" in *Colonies et Marine* for October, 1920 (Vol. 4, pp. 599–620). This presents a brief sketch of the various physiographical features and their influence on economic conditions; it shows how relief and hydrography tend to impede communication between the coast and the interior; how botanic and zoölogical zones run in a general way east and west corresponding with the climatic zones and causing a range in the type of vegetation cover from the tropical forests of the south, through the savana belts of the Sudan, to the deserts of the north; and finally how the density of population is greatest in the intermediate savana belt. This leads to a discussion of the most advantageous means for the utilization of the geographic factors: river floods for irrigation, areas for the raising of cattle and goats, and means for making available the human resources of the country. We find here a strong plea for the reconstruction and sanitation of villages and for the improvement of the methods of transport and intercommunication as a means for preserving and fully utilizing the labor supply which these human resources represent.

The various subjects touched upon by Hubert are all dealt with in greater detail by others. From notes made during a six months' tour of investigation through the colonies, H. Cosnier presents a conservative estimate of agricultural possibilities (*Colonies et Marine*, Vol. 4, 1920, pp. 85–120); the future of cattle raising is treated in an optimistic vein by R. Chudeau (*La Géographie*, Vol. 32, 1918, pp. 196–199) who believes that the available area and conditions are almost as favorable to this industry as in Argentina; the prospects of introducing wool culture on a large scale are studied by Yves Henry in *L'Agronomie Coloniale* (quoted in *Colonies et Marine*, Vol. 3, 1919, pp. 313–314); and French medical science is interesting itself for economic as well as humanitarian reasons in the preservation of the population from scourges like the sleeping sickness (Jean Paraf: L'hygiène en Afrique Occidentale Française, *Colonies et Marine*, Vol. 3, 1919, pp. 786–788).

Most stress, however, has been laid on the urgency of carrying out public works on a large and comprehensive scale. An editorial on the subject in *L'Afrique Française* (December, 1920, p. 342) gives what we may regard as the gist of French opinion on this subject. Here it is asserted that the examples of Brazil and Argentina "permettent d'affirmer que l'essor du pays sera fonction de l'outillage dont il sera pourvu," and statistics are given showing that the commerce of French West Africa has uniformly followed the completion of great public works in an ascending curve.

Foremost among public works is the improvement of lines of communication, in regard to which there are two schools of thought. One school favors the extension and linking up of the lines now in existence; the other wishes to tap the resources of the Sudan and, in fact, of the whole region by the construction of a trans-Saharan railway and holds that this would obviate the necessity of building up a French merchant marine to rival the merchant marines of foreign countries in the shipment of African products. Various trans-

Saharan railway projects of the past are explained by Major Bettembourg together with a compromise scheme of his own (*Colonies et Marine*, Vol. 3, 1919, pp. 592–624, 666–679). French imperialists of militaristic leanings would like to see the entire colonial domain in Africa knit together by a network of railways built primarily for strategic purposes (the movement of troops to Europe) and only secondarily with commercial motives in view (Paul Bluysen, in *Colonies et Marine*, Vol. 3, 1919, pp. 106–117; Sallandrouze de la Marnaye, in *L'Europe Nouvelle*, quoted in *Colonies et Marine*, Vol. 3, 1919, p. 405).

A more conservative school is represented by the former Governor-General Angoulvant and by Lieutenant-Governor Antonetti of the Ivory Coast. From a careful analysis of the geographic factors of French West Africa, physical, vegetal, and human, Angoulvant (*Colonies et Marine*, Vol. 4, 1920, pp. 531–563) came to the conclusion that the best interests of France and of the colonies themselves can be served only if plans for the construction of railways are made after a thorough consideration of all these factors and their interrelations. The determination of the routes and of the areas to be opened up must depend on a variety of circumstances such as: accessibility of the sea and of a port; density of population; topography; potentiality of a given area to increase its productive capacity, etc. On the basis of such considerations Angoulvant elaborates a plan out of which, were it once put into effect, would evolve the entire future economic development of French West Africa. The evolution of the human geography of an undeveloped country from a primitive state into one of relatively complex organization generally procedes more or less at haphazard. Angoulvant's plan, were it adopted, would direct this process along channels worked out by science; it would mean the putting into effect of applied science (here applied geography) on a scale of almost unparalleled magnitude.

Though they differ as to details, Angoulvant, Antonetti, and the other representatives of the conservative policy are in agreement in the general outline of their plans for the building of railways: as railway freights are high in comparison with ocean freights, lines should be so constructed that they will connect interior centers of production with the seaboard by the shortest possible routes. The railway now in existence connecting the upper Niger with the Senegal and with Dakar should be improved; the lines, now running but a few hundred miles into the interior, in French Guinea, in the Ivory Coast, and in Togo and Dahomey should all be extended in order to reach the thickly peopled savana regions of the Sudan; ultimately they should all be linked together by a system of railways parallel to the coast and by the improvement of navigation on the Niger and Senegal Rivers. Of these various projects, the one of foremost importance is the extension of the existing line through the Ivory Coast to Buake so that it will reach Wagadugu in the newly constituted colony of Haute Volta. This portion of the Sudan, of all of French West Africa, combines the greatest density of population with the greatest possibilities of future productive development, and it will find an easy approach to the sea through the Ivory Coast by a railway which will make available to the other colonies its wealth in labor resources.

A corollary to the building of railways is the improvement of ports. As transfer charges without adequate dock facilities are almost prohibitive, every effort should be made to deepen the harbors and to improve the mechanism of transshipment. The port that deserves immediate attention above all others (except, perhaps, Dakar) is the one destined to be the terminus of the Ivory Coast Railway, i.e. either Grand Bassam or Abidjan. In the August, 1919, number of *Colonies et Marine* J. C. Paulme urges that the French government take speedy action to make this port available for vessels of large draft and to perfect its dockage facilities if it does not wish to see the commerce of the Sudan drawn away over the newly constructed railway in the neighboring British Colonies of the Gold Coast and Ashanti.

AFRICA

The Hydrographic History of Lake Tanganyika. Tanganyika is a lake to intrigue the geographic imagination. It lies in a remote region where physical phenomena have been developed on a grand, a "spectacular" scale—the great *Graben*, the great massif of Ruwenzori, the volcanic Mfumbiro, "Mountains of the Moon." Tanganyika itself is mysterious in its great deeps (over 1,400 meters, a lacustrine depth exceeded only in Lake Baikal), its peculiarities of discharge, and the strange fauna that led Moore to pronounce it a *Reliktensee* (to the argument opposed to this theory a recent addition is made by Louis Germain: Histoire océanographique des lacs de l'Afrique orientale, *Bull. l'Inst. Océanogr. No. 369*, 1920). These aspects are touched on by R. Theeuws, Chief Engineer of the Colony of the Belgian Congo, in a series of articles in *Le Mouvement Géographique* (December 5 and 19, 1920; January 30, March 6, April 10, May 8, 1921) that envisage the past, present, and future of the lake. The remote past is dealt with lightly, being treated as it bears on the recent past and the most important event in the history of Tanganyika as it concerns us today—the opening of the Lukuga outlet.

Less than 50 years ago Tanganyika was a basin of interior drainage. At a date fixed by Theeuws as 1878 a breach was made in the basin through the Lukuga valley, since which *débâcle* the Lukuga has functioned as effluent of the lake. By some the phenomenon has been ascribed to river capture. Theeuws finds it simply overflow of the lake, gradually filling through excess of water gained by precipitation in the basin over water lost by evaporation. He also denies that the Lukuga has acted as an intermittent outlet.

We know something of Tanganyika in 1840 through Arab reports. Burton and Speke were the first Europeans to sight the lake (1858). Livingstone saw it in 1869 and again in 1871 when Stanley found him at Ujiji. Stanley again saw the lake five years later. During this period its waters were rising at a mean rate estimated by Theeuws as 18 centimeters a year. He also estimates the highest level of the lake, when the *débâcle* of 1878 occurred, as 782 meters above mean sea level. Physiographic interest concerning the *débâcle* is concentrated on the outlet. M. Theeuws apparently is in agreement with the theory that the primitive Lukuga valley antedates the formation of the lake, being part of an east-west flowing river He discusses sympathetically, however, Stanley's hypothesis of the former existence of two lakes, the southern and higher of which drained westward through the Lukuga until a diastrophic movement broke down the barrier between the lakes (the present lake is characterized by two basins separated by a submarine bar covered with 250 meters of water) and precipitated the southern waters into the northern lake, causing the abandonment of the Lukuga. However this may be, the primitive Lukuga, which had evidently accomplished much erosion in approximating a graded course, was left dry except for the waters of tributary torrents. These filled up the valley floor and, with the swamp vegetation that throve thereon, built a barrier, estimated to be 14 meters thick, at a distance of 16 kilometers from the lake. When Stanley saw it in 1876 he predicted the imminence of the *débâcle.* It appears to have begun with the April-May rains of 1878, though probably attack on the barrage by seepage and the work of wind and wave in flood had been in operation for some years previously.

The year before 1876 seems to have been a time of rapid rise in the lake. A similar condition is reported for Victoria Nyanza (H. G. Lyons: The Physiography of the River Nile and Its Basin, Cairo, 1906). By 1888 the *débâcle* appears to have been completed, and the lake attained what may be termed a stage of relative stability. Since then the level of the lake has fluctuated in sympathy with meteorological variations. A minimum stage was reached in the middle nineties. From 1912 to 1917 there was a rapid rise, since when there has been a fall. Difference between the maximum and minimum stages amounts to some 2 meters. This, in conjunction with the annual variation of high and low waters and the imperfect function of the Lukuga as a regulator, is a matter of importance as regards utilization of the waters of the lake.

M. Theeuws briefly discusses the utilization for hydraulic force, for irrigation, in connection with port construction on the lake, and for a far-reaching project, the improvement of the fluvial régime of the Congo system. Navigation on the shallow waters of the Upper Congo streams is seriously impeded during the dry season. The building of a barrage at the outlet of Tanganyika would permit of a considerable control by the use of flood waters during the low stages of the Lualaba, August to November. Before such a project can be carried out more data must be collected, and such will be welcome from the scientific as well as the practical standpoint. Up to the present, precise observations on the hydrography of Tanganyika have been scant indeed. Observations of this category and on the topography of the lake shores and the Lukuga valley, as well as the general region, are necessary for reconstruction of the past of the lake. As M. Theeuws says, speculations on the history of Tanganyika rest at present on few facts and many hypotheses.

The Desiccation Theory of Northern Africa. In "The Encroachment of the Sahara on the Sudan" (*Journ. African Soc.*, Vol. 20, 1921, pp. 174–185; 259–269) E. William Bovill summarizes the chief arguments relating to the desiccation theory of northern Africa. While it is generally agreed that northern Africa has witnessed climatic oscillations in the past, there is disagreement as to the present trend. Naturally it is in the critical areas bordering the desert, especially the Sudan, that we look for evidence. Gautier, who believes that the desert is gaining on its northern fringe, thinks that the contrary is taking place on the Sudanese edge. Chudeau is of the same opinion. He regards the present as a period of increasing humidity in French West Africa, his strongest argument being the fixation of dunes. On the other hand, Hubert, also an eminent geologist, finds different interpretations and contrary evidence in the same region. He has gone into the matter more fully than any other observer. A detailed statement of his painstaking investigations has recently appeared ("Le dessèchement progressif en Afrique Occidentale," *Bull. Comité d'Études Hist. et Sci. de l'Afrique Occidentale Française*, 1920, No. 4, pp. 401-467). In Senegal in recent years rivers have ceased to flow or have become increasingly brackish, wells have failed, desert sands have advanced, crops have failed. M. Hubert believes that, while there are doubtless several contributory factors, diminution of rainfall is the basal cause.

Unquestionably man has been an agent in part responsible for local desiccation in northern Africa as elsewhere. It seems to be a law that in the desert and along its edge abandonment of cultivation means that the desert will creep in just as in a more humid region destruction of the forest is indirectly, if not directly, a cause of diminished humidity. Of the gain of the Sahara on its interior oases and fertile fringes there are innumerable instances from the decadence of Roman Africa to the recent decline of prosperity in the Fezzan region of Tripoli. The precipitate withdrawal of the Italians from Fezzan on entry of the war was followed by nomad invasion from the desert; wells were filled up, palm groves and gardens destroyed, and the cultivator was hopelessly discouraged.

It is a question how far movement of the restless tribes and their relation to the sedentary peoples is effect rather than cause of declining prosperity. Mr. Bovill in particular takes up the case of the peoples of Sokoto province, Northern Nigeria. The population is unevenly distributed. "In the south there are well-watered areas which are only sparsely inhabited. But in the more arid north, owing to immigration from French territory, every square yard of cultivable land is occupied." Except to careful and continued observation the southward movement may escape notice (quoting the Resident), "First, because the population is in layers. Where Habe farmers have been driven out by drought and diminishing yields, the Fulani or Adarawa, with their live stock and lighter methods of agriculture, are glad to take their place. . . Again, when the grazing becomes too poor for the cattle, the Buzai and Tuarek, with their sheep and camels, are pleased to come in. The second cause of this movement escaping notice is that it is so gradual and never for any great distance at a time. The community does not rise in flight like locusts and arrive *en masse* in a new area. It is rather the continued hopping from field to field, from district to district, devouring all as it goes. . . The rearguard of the swarm has fortunately not yet reached this province. They are the sedentary Tuarek and Buzai on our northern borders. Beyond them are the nomad Tuarek of the desert."

It is interesting to note that a similar movement is reported from the southern part of the continent. Professor Schwarz in his book, "The Kalahari, or Thirstland Redemption" (see below) bases this deduction on an analysis of census returns made by W. M. Macmillan ("The South African Agrarian Problem, and Its Historical Development," Johannesburg, 1911). There has been a decline in the central sections of the Union and a drift towards the northern and eastern Transvaal and still farther north. Possibly this is analogous to the decline in population in Kansas and adjacent states in the mid-nineties, when a series of dry years followed years of good rain, and may simply represent the relative instability of settlement in a pioneer country. In northern Africa, too, the recent evidences of increased dryness may be simply short-period fluctuations. But whether aridity be periodic—long or short—or secular, it is not, as Mr. Bovill points out, a mere academic question. In such a region as the Sudan, where nomad and sedentary peoples live side by side in a condition of unstable equilibrium, it is a matter fraught with political significance.

The Redemption of the Kalahari. The theory of progressive desiccation of Africa has one of its most active exponents in E. H. L. Schwarz of Rhodes University College, Grahamstown, South Africa. Professor Schwarz has particularly devoted his attention to the southern part of the continent where desiccation—of which there are numerous indications—has not progressed as far as in the north and where, according to him, the disastrous consequences can be remedied. The author's numerous writings on the subject have been brought together in book form under the title, "The Kalahari, or Thirstland Redemption" (Cape Town, 1920), while a still more recent discussion, "The Control of Climate by Lakes," has appeared in the March number of the *Geographical Journal* (Vol. 57, 1921, pp. 166–181).

Professor Schwarz's proposed remedy is bold and original. He is not going to accomplish the redemption of the southern African deserts by the ordinary methods of irrigation. Instead, he proposes to change the climate. So far his ambitious project has appealed more to the masses of South Africa than to the scientists. Yet if one is sceptical concerning the ultimate accomplishment of the Kalahari scheme, it must at least be admitted that only theories oppose the consummation of it and not laws. In other words there is a chance that Professor Schwarz is right.

The steps in the argument are:

1. The desiccation of Africa is due to the draining of the continent by head-stream erosion and river piracy.

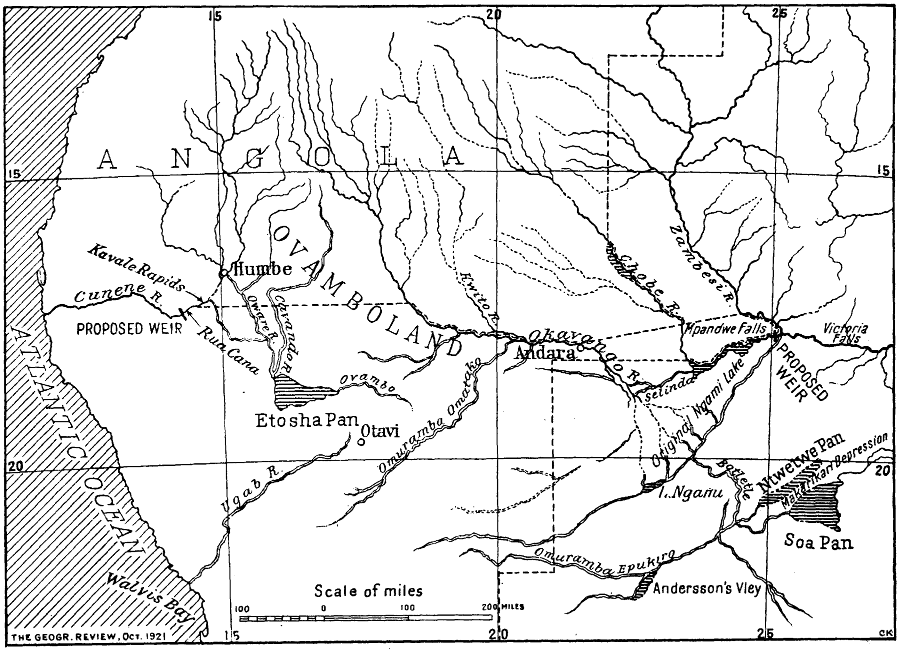

FIG. 1—Sketch map of the region included in Professor Schwarz's scheme for the redemption of the Kalahari. (On the above map for Cunene read Kunene.)

Scale approximately 1:15,000,000.

2. With desiccation irrigation is a losing venture or a temporary expedient, since an increasing amount of the water will be lost in evaporation and a constantly decreasing land area only can be utilized and then only by chemically treated soils in order to avoid brak (alkali).

3. The desiccation will be halted by the artificial prevention of river piracy and by the damming of such spillways as lead the waters from the interior to the ocean.

4. Then will be recreated in the interior of the Kalahari a great interior sea which will act as a humidifier of the atmosphere of the area and thereby increase the rainfall.

Concerning the first of these points, Professor Schwarz attempts to show that the topography of Africa is an underlying cause of the extensive aridity. The high areas of the continent, many of them divides, being adjacent to the coast result in short and swift coastal streams and long and more sluggish interior streams. The more active coastal streams have in many instances tapped the interior streams and turned water which in times past entered the interior back to the ocean. For example, some of the headwaters of the Niger have been captured by the Volta; and other headwaters are threatened by the Bandama River. It is confidently asserted, with ample evidence, that Ovamboland was at one time more moist than now and that water stood in the depression of Etosha Pan continuously. The desiccation of this area has been caused, according to Schwarz, by the coastal stream, the Kunene, tapping the interior Kunene (formerly an independent stream flowing towards Etosha Pan) at Kavale (Kambele) Falls and diverting the waters from Ovamboland; and on the east further desiccation of the area was effected as a result of the tapping of the interior streams by the Zambesi River at Victoria Falls.

In the second place, irrigation alone is not successful in redeeming these areas, (1) because the areas under irrigation are so small in comparison with the vast spaces of arid land that the desert conditions are not relieved, (2) because, in the dry air which obtains, water is quickly brought to the surface and the soil is thus rendered brak, and (3) because by the silting up of the reservoirs the amount of storage space is rapidly diminished. Professor Schwarz uses as illustrations of these points, first, Van Wyk's Vley and, second, the Bloemfontein Reservoir. Van Wyk's Vley, opened in the late eighties, is now largely abandoned because of brak, and in the area still operated an earning capacity of less than two per cent on the capital invested is realized. The Bloemfontein Reservoir, which was built to hold a three years' supply of water, was actually found to have in the drought of 1919 less than a six months' supply as a result of the rapid silting and filling processes.

The prevention of the desiccation and the remedy for the failures of irrigation are easily accomplished according to Schwarz's plan by reversing the process of stream capture and turning the waters again to the interior. In the case of Ovamboland this will be accomplished by building a dam or weir across the Kunene River above the "small cataracts" (Kavale Rapids) and diverting the waters into the abandoned channels which lead to the dried-up basins of Ovamboland and Etosha Pan. A second weir will be built across the Chobe just above its confluence with the Zambesi by which its waters will be directed southwards in old channels and, with the waters of the Okavango and possible overflow from Etosha Pan, will form a lake in the Makarikari depression in which lie Ntwetwe and Soa Pans. The estimated areas of water in Etosha Pan and Makarikari Lake will amount to 20,000 square miles, and there will be 10,000 square miles of irrigated land to which can be added a further 70,000 square miles in Ovamboland restored to fertility.

So far the scheme is well within the bounds of probabilities, though the lakes thus created may not be so large as anticipated and may not be constantly maintained. The next point in the argument is more difficult and cannot be so readily accepted. With the exposure of this great surface of water in the desert evaporation will be increased until the air becomes normally more humid; and this in turn will increase the rainfall, and the flow of the streams will be correspondingly augmented. This is best stated in the case of Lake Chad.

"A large portion of the drainage into Lake Chad has been cut off by the boring headstreams of the Benue, and every year these, having higher gradients than the tributaries feeding the Chad rivers, are claiming more and more territory. If evaporation from the water surface in Lake Chad is sufficient to give half an inch of rain in the Sahara, this has no appreciable effect on the country; were the area ten times as great as it apparently was formerly, five inches of rain would make a distinct change in the country, and in addition, the air being moist while the evaporation was proceeding, rain-laden clouds blowing in from outside would be reinforced, and additional rain would be secured in that way."

Professor Schwarz's scheme has been criticized on meteorological and engineering grounds. In particular, it has been challenged by F. E. Kanthack, Director of Irrigation for the Union of South Africa, who asserts that the requisite amount of water cannot be furnished —at least in the case of the Kunene River. This is in part admitted by Schwarz, who states that 5.5 x 10^{12} cubic feet of water will be required (for the entire scheme) while he estimates the annual flow of the tributary streams as 2.5 x 10^{12} cubic feet. His scheme stipulates that "this water will remain in the country and result in increased precipitation, so that next year there will flow into the lake 2.5 units of new water, and an appreciable quantity of water returned to it from last year's supply." Mr. Kanthack (who has recently acted on the commission for field investigation of the disputed Angola-Southwest African Protectorate boundary) describes the physical character of the Kunene River section in some detail in "Notes on the Kunene River, Southern Angola" in the May number of the *Geographica Journal* (Vol. 57, 1921, pp. 321–336).

A second line of criticism considers the increasing depth of silt over Ovamboland as a cause of the disappearance of the waters and a reason for less flow than formerly. In the same connection this silt would have a material effect in reducing the amount of water in the catchment basin of the proposed lake.

More serious and at the same time less confident criticism is hurled against the humidification expectations of Professor Schwarz. The examples cited to maintain his argument are exceedingly weak, for which he is not particularly to blame as no case of complete experimentation and research along these lines is available. The natural illustration of the Salton Sea, quoted by C. E. P. Brooks in an interesting review of Professor Schwarz's book (*Quart. Journ. Royal Meteorol. Soc.*, Vol. 47, 1921, pp. 72–74) is on a considerably smaller scale. It is worth noting that a similar solution for relieving the aridity of northeastern Brazil has recently been proposed ("O problema das seccas do Nordeste resolvido por Luiz Mariano de Barros Fournier," Rio de Janeiro, 1920, reviewed in the *Meteorol. Mag.*, Vol. 56, 1921, pp. 46–47).

In general, however, it is the opinion that the creation of such water areas as Schwarz proposes would not produce enough humidity of the atmosphere to obtain the results predicted. Here is a line of investigation that must be pursued. Whether Professor Schwarz's scheme materializes or not, presentation of the project has brought to light a number of lines for investigation which ought to attract attention.

R. M. Brown

AUSTRALASIA AND OCEANIA

Modifying Climate by Human Agency in Southeastern Australia. To the argument on possibilities of modifying climate by human agency discussed above a further contribution is made by E. T. Quayle, meteorologist to the Australian Commonwealth, in the May issue of the *Proceedings of the Royal Society of Victoria* ("Possibilities of Modifying Climate by Human Agency, with Special Application to South-Eastern Australia"). Mr. Quayle is of the opinion that under the natural climatic conditions of southeastern Australia increase of the "evaporation surface" will normally be accompanied by increased rainfall, in demonstration of which he presents actual measured evidence. In New South Wales and South Australia near the northwestern border of Victoria large areas formerly under Mallee scrub (dwarf eucalypts, which transpire little) have been brought under grass and cereal cultivation, a better evaporation surface. Data from meteorological stations in such areas compared with those from unimproved areas show an increase in the amount and proportion of the spring (the critical) rainfall with cultivation. Figures for the yearly rainfall for irrigated areas indicate a similar response. A study of the monthly rainfall for 1919, a year of record irrigation, shows increased rainfall over irrigated districts and in their lee. It was in the last decade that the greatest advance was made in irrigation and cultivation of the Mallee. The mean rainfalls for this period compared with that of the 30-year period, 1885–1914, are above the general average for the improved land, whereas for other areas the figures for the last decade are below the average.

Mr. Quayle, however, plainly states that the question of improved rainfall is a matter of delicate balance. The artificially increased evaporation must bear an adequate relation to the normal humidity of the upper air. "It is hardly necessary to remark that it is in rainy weather that the principal additions to the rainfall must be made by local evaporation. Under generally anticyclonic conditions, as in some of our great drought years, the rains must largely fail." It is one of the critical points in the practicability of such a project as Professor Schwarz's Kalahari scheme (see above).

WORLD AS A WHOLE AND LARGER PARTS

The Southern Ocean and Islands East to South of Cape Horn. The Southern Ocean has long been notorious for its dismal raw climate with but infrequent breaks in the cloudy skies and succession of storms. What can attract the white man to the bleak Falkland Islands, South Georgia, and South Shetlands? On the leeward (drier) portion of southern Patagonia and Tierra del Fuego (south of 50° S.) sheep raising is practically the only occupation other than fishing. The Falkland Islands (area 6,500 square miles), 250 miles to the east, similarly are noted for sheep raising and are the home of some 2,000 people, mostly Scotch shepherds. South Georgia, 900 miles still farther east and in the same latitude as Cape Horn, is too cold and stormy for sheep raising and, therefore, is all but uninhabited except in the lighter slightly warmer months when most of the whaling is done. The western slope of this island of 1,600 square miles is permanently snow-covered down to 2,000 feet above sea level, and all valleys are filled with glaciers. In marked contrast the eastern slope, swept occasionally by warm, dry *föhn* winds down from the mountains, has no accumulation of snow even in winter. A similar though less marked *föhn* wind occurs on the eastern side of East Falkland. An ice-laden current makes both the Falklands and South Georgia appreciably colder than South America at corresponding latitudes. The South Orkneys (see "Climate of the South Orkneys," *Geogr. Rev.*, Vol. 1, 1916, p. 305), South Shetlands, Graham Land, and the volcanic South Sandwich Islands are generally ice-covered and ice-enclosed and practically useless even as shelter for whalers.

Detailed, accurate meteorological records for 13 years at Cape Pembroke (eastern cape), East Falkland, and for 11 years at Grytviken, Cumberland Bay, South Georgia, and other broken records have been summarized recently by C. E. P. Brooks in a monograph which may be used as a model for thorough and effective presentation of climatic data ("The Climate and Weather of the Falkland Islands and South Georgia," *Geophys. Memoirs No. 15*, Meteorological Office, London, 1920, pp. 95–146). The data for each element—pressure, temperature, relative humidity, cloudiness, sunshine, precipitation, fog and winds—are presented by months and hours of the day in tables and diagrams.

An interesting feature in the storminess is that it is no less in summer than in winter, while spring and fall are even stormier. Contrary to the seasonal shifting of wind and storm belts in other parts of the world, southern cyclones follow tracks farther from the pole in summer than in winter. The reviewer thinks that this may explain in part the lack of any summertime let-up in storminess. The procession of cyclones passing on the south results in northwest to southwest winds almost exclusively at Cape Pembroke and Grytviken. The temperatures are those of a subarctic marine climate at Grytviken, with a small annual range (February 43.5° F., July 27.9° F.) and a small daily range (12.2° F.). Cape Pembroke has a smaller range and a temperature averaging about 7° F. higher. Hot weather and extremely cold weather never occur, the absolute extremes at Grytviken being −2.6° F. and 79.7° F. The relative humidity and cloudiness at Cape Pembroke are high throughout the year. The lack of sunshine is evident from the fact that only in the three midday hours of February does the sunshine exceed 50 per cent of the possible. In June it is not as much as 30 per cent even at midday. The rainfall (about 25 inches at Port Stanley and 56 inches at Grytviken) is moderate and evidently much less than on the western parts of the islands. At Port Stanley the maximum, in May, is about double the minima, in October and January; and at Grytviken the maximum, in January, is about double the minimum, in September. At Cape Pembroke precipitation occurs on the average of two days out of three (253 days a year), and snow 54 days. At Grytviken precipitation days are 196 and snowfall days 109. Snowstorms are fairly frequent even in summer. Days with fog average 54 a year at Cape Pembroke and 25 at Grytviken. Strong winds prevail two-thirds of the time at Cape Pembroke.

The weather of this out-of-the-way region is doubly of interest. The meterorologist now appreciates the truth of Maury's conclusion of more than 60 years ago, when, referring to the Southern Ocean, he said, "It is a reservoir of dynamic force for the winds, a regulator in the grand meteorological machinery of the earth." R. C. Mossman says that Antarctic weather conditions may be used as a factor in predicting (1) the rains and height of rivers in Argentina, (2) the monsoonal intensity in India, and (3) the temperature of Kimberley, South Africa. The geographer views the inclement weather as the prime factor which limits the industries of this region essentially to whaling, sealing, and fishing—agriculture being impossible. In the waters of the dependencies of the Falkland Islands is located the world's greatest whale fishery, with an annual catch which in one year of the past decade rose to nearly 12,000 whales, valued at about £2,000,000. The nearer the southern ice pack the more numerous the whales, apparently because the more abundant the food (shrimps largely) The whalers, therefore, must endure most unfavorable weather and seas and in summers with much pack ice find their usual hunting grounds inaccessible. Considering the almost continuous rough weather and the practical lack of ice-free land and harbors, it is surprising that such a large industry can be prosecuted successfully (compare the note on whale fisheries of South Georgia, *Geogr. Rev.*, Vol. 6, 1918, pp. 286–288).

But there are possibilities for more than doubling the economic resources of this otherwise useless region. Fur seals can perhaps be re-established to replace the herds exterminated in 1821 and 1822, in which years Weddell estimates that 1,200,000 skins were taken from South Georgia and 320,000 from the South Shetland rookeries. Fisheries may be established to supply at least a portion of the 67,000 odd metric tons of fish, valued at about $15,000,000 imported into Argentina, Uruguay, Brazil, and Chile (statistics of 1913, 1914, or 1915). The waters of the Dependencies must be teeming with fish, for how otherwise could the tens of thousands of sea elephants and millions of penguins live here?

In 1917 an appreciation of the imminent danger of exterminating the whales led to the formation of an Interdepartmental Committee on Research and Development in the Dependencies of the Falkland Islands. The report of this committee, with voluminous appendixes, bibliography, and very complete index, was recently published (H. M. Stationery Office, London, 1920). It covers in detail the hydrography, geology, meteorology, flora, fauna, history, industries, and possibilities of the region south of 50° S. in longtitudes 20° to 50° W., and south of 58° S. in longtitudes 50° to 80° W.—the region southeast and south of Cape Horn. More than half of the publication treats in detail of whaling and the biology of whales. The committee urges sending a fully equipped scientific expedition, with biologists, meteorologist, geologist, and surveyors in two ships. Perhaps three years would be required to complete a satisfactory study of the life histories, habits, and migrations of whales, seals, and other fauna of commercial value and to make a hydrographical survey of the region.

CHARLES F. BROOKS

HUMAN GEOGRAPHY

Travel As a Form of Human Enterprise. Enormous as has been the number of books of travel, of tourists' guides and travelers' handbooks, of collections of voyages, of histories of exploration and discovery, relatively few have dealt with the history of travel. Particular travelers and their expeditions have received much attention, but there is a broad and fresh field for research and historical synthesis in the history of travel as a form of human enterprise.

The motives that have induced men to leave their homes and take to the road have varied greatly with the ages, though war and the search for commercial gain have been perennial. During the long centuries of peace under the Roman Empire, pleasure traveling was indulged in for much the same reasons that prevail at the present time. Historic spots were visited, and the more striking natural curiosities were sought out—Etna, the currents of the Euripus, famous groves, grottoes, etc. The Romans were also lovers of nature in her milder aspects (see Sir Archibald Geikie: The Love of Nature Among the Romans, London, 1912), but there is abundant evidence that they had little or no eye for the wilder beauties of mountain scenery. In a little book entitled "Travel Among the Ancient Romans" (Boston, 1920) Professor W. W. Mooney, of Adelphi College, has recently gathered together many interesting data on Roman roads—the extent of travel, animals, equipment, ships, and vehicles used, with an enlightening chapter on Roman inns. Mooney does not claim to contribute much that is original, and his book in no way supersedes Friedländer's classic and far more penetrating discussion of the subject in his "Roman Life and Manners." "Travel Among the Ancient Romans," however, is a handy and readable reference book which renders conveniently available in cheap form information that would otherwise be difficult to obtain.

In the Middle Ages pilgrimage, war, commerce, and diplomacy were about the only motives that displaced men from their accustomed haunts. On travel during the later medieval period there is no more delightful book than Ambassador Jusserand's "English Wayfaring Life in the Middle Ages (XIVth Century)" which has recently been published in a new and enlarged edition (New York, 1920). This fascinating and profound study of life on the roads and in the taverns of fourteenth-century England first appeared in English in 1889 and ever since has enjoyed a well-deserved popularity. The fourteenth century was a time when the roads of England swarmed with wayfarers of all kinds: merely to quote Jusserand's chapter headings, with "herbalists, charlatans, minstrels, jugglers, messengers, merchants, pedlars, outlaws, wandering workmen, preachers, friars, pardoners, and pilgrims." "At a period when, for the mass of mankind, ideas were transmitted orally and travelled with these wanderers along the roads, the nomads served as a link between the human groups of various districts." On the highways and in the inns the untutored man of the age gathered what little he could learn of geography.

With the Renaissance traveling for pleasure began again. The complete and well-rounded man was the ideal of this great age, and travel was thought to be an essential aid toward the attainment of that ideal; the travelers of the Renaissance were interested above all in man and his works. Young Englishmen in the days of the Tudors and Stuarts frequented the Continent to learn foreign languages and customs and to make the grand tour held to be so vital a part of their education. Clare Howard discusses this aspect of the history of travel in an entertaining book, "English Travellers of the Renaissance" (London, 1914).

The Romantic movement of the eighteenth and early nineteenth centuries ushered in a new epoch of pleasure traveling. Probably for the first time great numbers of men began to appreciate the beauty of wild scenery and of mountains (Francis Gribble: The Early Mountaineers, London, 1899; and W. W. Hyde: The Development of the Appreciation of Mountain Scenery in Modern Times," *Geogr. Rev.*, Vol. 3, 1917, pp. 107–118). Regions that in earlier days were shunned as hideous and horrible now become the haunt of a new kind of pilgrim, the mountaineer.

Dr. Mill on Regional Geography. "Hasty generalization," as an eminent geographer has recently said, "has long been an evil in geography." General geography can rest firmly only on a basis of clearly established facts; in other words it is dependent on the well-determined facts and relations of regional geography. Herbertson's great contribution to geography was his insistence on regional study. So Dr. H. R. Mill reminds his audience in the Herbertson Memorial Lecture for 1921 ("The Value of Regional Geography, an Address before the Geographical Association of Great Britain," *Geogr. Teacher*, Vol. 11, 1912, pp. 7–19). Dr. Mill himself has long insisted on the need for regional study. Twenty-five years ago he advocated the preparation of a detailed geographic description of the British Isles and drew up a scheme for its execution based on the Ordnance Survey map sheets 1 inch to 1 mile (*Geogr. Journ.*, Vol. 7, 1896, pp. 345–365). Later an example of the proposed treatment was given in "A Fragment of the Geography of England" (*Geogr. Journ.*, Vol. 15, 1900, pp. 205–227 and 353–378). The scheme, as Dr. Mill had foreseen, proved only a "seductive dream"; but could it have been carried out as planned it would have been virtually completed when the war broke out, and "the total cost could have been saved ten or a hundred times over in the prevention of waste on aerodromes on impossible sites, or attempt to cultivate land unsuited by its nature for agriculture, and by the utilization of water power to conserve coal; to mention only a few of the applications to which it might have been put."

In his address Dr. Mill illustrates the significance of regional study through the phase with which he has been most intimately connected—the rainfall map of the British Isles. At the time of Dr. Mill's retirement in 1919 about half the map (average rainfall on a scale of 2 miles to the inch) had been completed. Its construction has involved the careful study of many data and a vast amount of experimentation in mapping. In the course of the work general principles governing the relation of configuration to rainfall have emerged. Added experience confirms the principles and gives the hope of determining quantitive as well as qualitative values. The rainfall map has a practical application in the natural distribution of surface water (river basins), whence one passes to questions of its control and utilization to what Dr. Mill calls a "water geography" (memoirs on river basins), a specialized form of regional geography.